

APR 08 1997
CC: C.A.S.I.
Rosa T / 2004
FINAL
7N-89-CR
025153

Final Technical Report for NASA-Ames Agreement No. NAG2-799

Title: Infrared Polarization Study of the Galactic Center Arc

term of grant: 10/1/92 to 9/30/96.

This Research Grant Award from NASA/Ames to UCLA supported a far-infrared polarimetric study of dense clouds in the Galactic center using the University of Chicago far-infrared polarimeter array, STOKES, aboard NASA's Kuiper Airborne Observatory (KAO). It represents a continuation of a project begun earlier.

During the funded time interval, two flight series were undertaken with the KAO, both during a deployment in Hawaii. Both were done in collaboration with the University of Chicago instrument group, led by Roger Hildebrand. The measurements made at 100 μm wavelength during the first series of flights, in August 1993, led to an extensive polarization mapping of the strong far-infrared source associated with the thermal, arched filaments of the magnetic structure known as the Galactic Center Radio Arc. This work considerably expanded the area mapped in the original investigation (Morris et al. 1992, ApJL, 399, L63). Far-infrared polarimetry provides a probe of the magnetic field orientation within the surface layers of the molecular cloud underlying the arched filaments where the emitting dust is located, and it showed clearly that the magnetic field is highly ordered and is largely parallel to the arched radio filaments.

The second flight series was carried out on 3 flights with the KAO in July 1995. This work represented the first successful use of the polarimeter at a wavelength of 60 microns. Previous polarimetry of the Galactic center with STOKES had been done at an effective wavelength of 100 μm , but the extension to shorter wavelengths made it possible to explore the polarized emission from warmer dust. The primary target of the 1995 observation was G0.18-0.04, an HII region lying at the surface of a massive molecular cloud located in the Galactic plane where the nonthermal radio filaments of the Radio Arc pass through the plane.

The results of this latter investigation were scientifically very interesting for several reasons: first, the polarization was both uniform and strong throughout the emitting region. No other source yet mapped displays such large percent polarization (up to 10%) over such an extended region, and the uniformity of the direction of polarization indicates a magnetic field which is itself very strong and uniform. Furthermore, the orientation of the polarization vectors implies that the magnetic field is parallel to the plane of the Galaxy within the emitting cloud. This means that the field in the cloud is perpendicular to the strong, large-scale field outside the cloud evidenced by the radio filaments which we have observed there. This striking contrast in field directions is shared by all of the galactic center clouds that have now been studied with the KAO and it has provided a healthy stimulus to thinking about magnetic interactions in the Galactic center. For example, it helped stimulate a model for the nonthermal radio filaments which Gene Serabyn and I offered (1994, ApJL, 424, L91).

publications resulting from grant NAG2-799 or making extensive use of this research:

"Far-Infrared Studies of the Galactic Center Arc Using the Kuiper Airborne Observatory," M. Morris, J.A. Davidson, & M. Werner, in "Airborne Astronomy Symposium on the Galactic Ecosystem: From Gas to Stars to Dust", eds: M.R. Haas, J.A. Davidson, & E.F. Erickson, ASP Conf. Ser. #73,, pp. 477 – 488 (1995).

"The Galactic Center Environment," M. Morris & E. Serabyn, *Ann. Rev. Astron. Ap.*, **34**, 645 - 701 (1996).

papers in preparation:

"The Magnetic Field near the Galactic Center," M. Morris, invited review to be presented in August 1997 at IAU Symposium #184 in Kyoto, Japan, will be largely based on the results from the research supported by grant NAG2-799.

"The Magnetic Field in the Cloud Underlying the Arched Filaments of the Galactic Center Arc," Morris, M. Davidson, J.A., Werner, M.W., Hildebrand, R., Dotson, J., Dowell, D., Schleuning, D. 1997a.

"Far-Infrared Polarization of G0.18-0.04: the Clash of Two Magnetic Systems," Morris, M. Davidson, J.A., Werner, M.W., Hildebrand, R., Dotson, J., Dowell, D., Schleuning, D. 1997b.

Other publications by collaborators featuring the data from this work:

"Far-Infrared Polarimetry," Hildebrand, R. et al. 1995, in "Airborne Astronomy Symposium on the Galactic Ecosystem: From Gas to Stars to Dust", eds: M.R. Haas, J.A. Davidson, & E.F. Erickson, ASP Conf. Ser. #73, p 97.

"The Magnetic Field Structure in the Galactic Center," J.A. Davidson, in ASP Conference Series, Vol. 97, eds. W.G. Roberge and D.C.B. Whittet, p 504 (1996).

Other KAO collaborations supported by this grant (these were based on observations with the facility Cryogenic Grating Spectrometer):

"Excitation of the E2 "Arched" Filaments near the Galactic Center," S.W.J. Colgan, E.F. Erickson, J.P. Simpson, M.R. Haas & M. Morris, *Ap.J.*, **470**, 882 – 892 (1996).

"Infrared Observations of G0.18-0.04," J.P. Simpson, Colgan, S.W.J., Cotera, A.S., Erickson, E.F., Haas, M.R., Morris, M. & Rubin, R.H. in press (1997).